

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification ⁶ : B65D 6/30, B21D 51/32</p>	<p>A1</p>	<p>(11) International Publication Number: WO 96/37414</p> <p>(43) International Publication Date: 28 November 1996 (28.11.96)</p>
<p>(21) International Application Number: PCT/GB96/00709</p> <p>(22) International Filing Date: 25 March 1996 (25.03.96)</p> <p>(30) Priority Data: 9510515.1 24 May 1995 (24.05.95) GB</p> <p>(71) Applicant (for BB GB IE KE LS MW SD SZ TT UG only): CARNAUDMETALBOX PLC [GB/GB]; Downsvie Road, Wantage, Oxfordshire OX12 9BP (GB).</p> <p>(71) Applicant (for AT BE BF BJ CF CG CH CI CM DE DK ES FI FR GA GB GN GR IE IT LU MC ML MR NE NL NO PT SE SN TD TG only): CARNAUDMETALBOX S.A. [FR/FR]; 153, rue de Courcelles, F-75817 Paris Cédex (FR).</p> <p>(71) Applicant (for AL AM AU AZ BG BR BY CN CZ EE GE HU IS JP KG KP KR KZ LK LR LT LV MD MG MK MN NZ PL RO RU SG SI SK TJ TM TR UA UZ VN only): CARNAUDMETALBOX N.V. [NL/NL]; Anodeweg 3, NL-1627 LJ Hoom (NL).</p> <p>(71) Applicant (for CA MX only): CARNAUDMETALBOX (HOLDINGS) USA INC. [US/US]; Suite 1300, 1105 North Market Street, Wilmington, DE 19801 (US).</p>		<p>(72) Inventors; and (75) Inventors/Applicants (for US only): BRIFCANI, Mouayed, Namdooh [GB/GB]; 2 Witan Way, Wantage, Oxfordshire OX12 9EU (GB). HINTON, Peter, James [GB/GB]; 3 Divity Close, Wanborough, Swindon, Wiltshire SN4 0EH (GB). KYSH, Mark, Christopher [GB/GB]; 60 Mill Street, Wantage, Oxfordshire OX12 9AN (GB).</p> <p>(74) Agent: GADSDEN, Robert, Edward; Carnaudmetalbox plc, Downsvie Road, Wantage, Oxfordshire OX12 9BP (GB).</p> <p>(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</p> <p>Published With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</p>
<p>(54) Title: CAN END AND METHOD FOR FIXING THE SAME TO A CAN BODY</p>		
<p>(57) Abstract</p> <p>A can end (22) comprising a peripheral cover hook (23), a chuck wall (24) dependent from the interior of the cover hook, an outwardly concave annular reinforcing bead (25) extending radially inwards from the chuck wall, and a central panel (26) supported by an inner portion (27) of the reinforcing bead, characterised in that, the chuck wall (24) is inclined to an axis perpendicular to the exterior of the central panel at an angle between 20° and 60°, and the concave cross-sectional radius of the reinforcing bead (25) is less than 0.75 mm.</p>		

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	GB	United Kingdom	MW	Malawi
AT	Austria	GE	Georgia	MX	Mexico
AU	Australia	GN	Guinea	NE	Niger
BB	Barbados	GR	Greece	NL	Netherlands
BE	Belgium	HU	Hungary	NO	Norway
BF	Burkina Faso	IE	Ireland	NZ	New Zealand
BG	Bulgaria	IT	Italy	PL	Poland
BJ	Benin	JP	Japan	PT	Portugal
BR	Brazil	KE	Kenya	RO	Romania
BY	Belarus	KG	Kyrgyzstan	RU	Russian Federation
CA	Canada	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic	KR	Republic of Korea	SE	Sweden
CG	Congo	KZ	Kazakhstan	SG	Singapore
CH	Switzerland	LI	Liechtenstein	SI	Slovenia
CI	Côte d'Ivoire	LK	Sri Lanka	SK	Slovakia
CM	Cameroon	LR	Liberia	SN	Senegal
CN	China	LT	Lithuania	SZ	Swaziland
CS	Czechoslovakia	LU	Luxembourg	TD	Chad
CZ	Czech Republic	LV	Latvia	TG	Togo
DE	Germany	MC	Monaco	TJ	Tajikistan
DK	Denmark	MD	Republic of Moldova	TT	Trinidad and Tobago
EE	Estonia	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	UG	Uganda
FI	Finland	MN	Mongolia	US	United States of America
FR	France	MR	Mauritania	UZ	Uzbekistan
GA	Gabon			VN	Viet Nam

CAN END AND METHOD FOR FIXING THE SAME TO A CAN BODY

This invention relates to an end wall for a container and more particularly but not exclusively to an end wall of a can body and a method for fixing the end wall to the can body by means of a double seam.

5 US Patent 4093102 (KRASKA) describes can ends comprising a peripheral cover hook, a chuck wall dependent from the interior of the cover hook, an outwardly concave annular re-inforcing bead extending radially inwards from the chuck wall and a central panel
10 joined to an inner wall of the reinforcing bead by an annular outwardly convex bead. This can end is said to contain an internal pressure of 90psi by virtue of the inclination or slope of the chuck wall, bead outer wall and bead inner wall to a line perpendicular to the centre
15 panel. The chuck wall slope D° is between 14° and 16° , the outer wall slope E is less than 4° and the inner wall slope C° is between 10 and 16° leading into the outwardly convex bead. We have discovered that improvements in metal usage can be made by increasing the slope of the
20 chuck wall and limiting the width of the anti peaking bead.

Our European Patent No. 0153115 describes a method of making a can end suitable for closing a can body containing a beverage such as beer or soft drinks. This
25 can end comprises a peripheral flange or cover hook, a chuck wall dependant from the interior of the cover hook, an outwardly concave reinforcing bead extending radially inwards from the chuck wall from a thickened junction of the chuck wall with the bead, and a central panel
30 supported by an inner portion of the reinforcing bead. Such can ends are usually formed from a prelacquered

aluminium alloy such as an aluminium magnesium manganese alloy such as alloy 5182.

Our International Patent Application published no. WO93/17864 describes a can end suitable for a beverage can and formed from a laminate of aluminium/manganese alloy coated with a film of semi crystalline thermoplastic polyester. This polyester/aluminium alloy laminate permitted manufacture of a can end with a narrow, and therefore strong reinforcing bead in the cheaper aluminium manganese alloy.

These known can ends are held during double seaming by an annular flange of chuck, the flange being of a width and height to enter the anti-peaking bead. There is a risk of scuffing if this narrow annulus slips. Furthermore a narrow annular flange of the chuck is susceptible to damage.

Continuing development of a can end using less metal, whilst still permitting stacking of a filled can upon the end of another, this invention provides a can end comprising a peripheral cover hook, a chuck wall dependant from the interior of the chuck wall, an outwardly concave annular reinforcing bead extending radially inwards from the chuck wall, and a central panel supported by an inner portion of the reinforcing bead, characterised in that, the chuck wall is inclined to an axis perpendicular to the exterior of the central panel at an angle between 20° and 60° , and the concave bead narrower than 1.5mm (0.060"). Preferably, the angle of the chuck wall to the perpendicular is between 40° and 45° .

In a preferred embodiment of the can end an outer wall of the reinforcing bead is inclined to a line

perpendicular to the central panel at an angle between -15° to +15° and the height of the outer wall is up to 2.5mm.

In one embodiment the reinforcing bead has an inner
5 portion parallel to an outer portion joined by said concave radius.

The ratio of the diameter of the central panel to the diameter of the peripheral curl is preferably 80% or less.

10 The can end may be made of a laminate of thermoplastic polymer film and a sheet aluminium alloy such as a laminate of a polyethylene terephthalate film on an aluminium - manganese alloy sheet or ferrous metal typically less than 0.010 (0.25mm) thick for beverage
15 packaging. A lining compound may be placed in the peripheral cover hook.

In a second aspect this invention provides a method of forming a double seam between a can body and a can end according to any preceding claim, said method comprising
20 the steps of:-

placing the curl of the can end on a flange of a can body supported on a base plate, locating a chuck within the chuck wall of the can end to centre the can end on the can body flange, said chuck having a frustoconical
25 drive surface of substantially equal slope to that of the chuck wall of the can end and a cylindrical surface portion extending away from the drive surface within the chuck wall, causing relative motion as between the assembly of can end and can body and a first operation
30 seaming roll to form a first operation seam, and thereafter causing relative motion as between the first operation seam and a second operation roll to complete a

double seam, during these seaming operations the chuck wall becoming bent to contact the cylindrical portion of the chuck.

Various embodiments will now be described by way of example and with reference to the accompanying drawings in which:-

Figure 1 is a diagrammatic sketch of known apparatus for forming a double seam;

Figure 2 is an enlarged sectioned side view of a known chuck and can end before seaming;

Figure 3 is a sectioned view of a fragment of a known double seam;

Figure 4 is a sectioned side view of a can end according to this invention before edge curling;

Figure 5 is a sectioned side view of the can end of Figure 4 on a can body before forming of a double seam;

Figure 6 is a like view of the can end and body during first operation seaming;

Figure 7 is a like view of the can end and body during final second operation seaming to create a double seam;

Figure 8 is a fragmentary section of a chuck detail; and

Figure 9 is a side view of the cans stacked one on the other.

In Figure 1, apparatus for forming a double seam comprises a base plate 1, an upright 2 and a top plate 3.

A lifter 4 mounted in the base plate is movable towards and away from a chuck 5 mounted in the top plate. The top plate supports a first operation seaming roll 6 on an arm 7 for pivotable movement towards and away from the chuck. The top plate also supports a second

operation seaming roll 8 on an arm 9 for movement towards and away from the chuck after relative motion as between the first operation roll and can end on the chuck creates a first operation seam.

5 As shown in Figure 1 the chuck 5 holds a can end 10 firmly on the flange 11 of a can body 12 against the support provided by the lifter plate 4. Each of the first operation roll 6 and second operation roll 7 are shown clear of chuck before the active seam forming
10 profile of each roll is moved in turn to form the curl of the can end and body flange to a double seam as shown in Figure 3.

Figure 2 shows on an enlarged scale the chuck 5 and can end 10. The can end comprises a peripheral curl 13,
15 a chuck wall 14 dependent from the interior of the curl, an outwardly concave anti-peaking bead 15 extending inwards from the chuck wall to support a central panel 16. Typically the chuck wall flares outwardly from the vertical at an angle C about 12° to 15°.

20 The chuck 5 comprises a body 17 having a threaded bore 18 permitting attachment to the rest of the apparatus (not shown). An annular bead 19 projects from the body 17 of the chuck to define with the end face of the body a cavity to receive the central panel 16 of the
25 can end. The fit of panel 16 in annulus 19 may be slack between panel wall and chuck.

The exterior surface of the projecting bead 19 extends upwards towards the body at a divergent angle B of about 12° to the vertical to join the exterior of the
30 chuck body 17 which tapers off an angle A° of about 4° to a vertical axis perpendicular to the central panel. The outer wall of the chuck 5 engages with the chuck wall at

a low position marked "D" within the 12° shaped portion of the chuck bead 15.

As can ends are developed with narrower anti-peaking beads the chuck bead 19 becomes narrower and more likely to fracture. There is also a risk of scuffing of the can end at the drive position D which can leave unacceptable unsightly black marks after pasteurisation.

Figure 3 shows a sectioned fragment of a typical double seam showing a desirable overlap of body hook 21 and end hook 20 between the can end 10 and can body 12.

Figure 4 shows a can end, according to the invention, comprising a peripheral cover hook 23, a chuck wall 24 extending axially and inwardly from the interior of the peripheral cover hook, an outwardly concave reinforcing or anti-peaking bead 25 extending radially inwards from the chuck wall, and a central panel 26 supported or an inner portion panel with 27. The panel wall is substantially upright allowing for any metal spring back after pressing. The chuck wall is inclined to an axis perpendicular to the exterior of the central panel at an angle C_1 between 20° and 60° ; preferably between 40° and 45° . Typically the cross sectional radius of the antipeaking bead is about 0.5mm.

Preferably the anti-peaking bead 25 is parallel sided, however the outer wall may be inclined to a line perpendicular to the central panel at an angle between -15° to $+15^\circ$ and the height h_1 of the outer wall may be up to 2.5mm.

This can end is preferably made from a laminate of sheet metal and polymeric coating. Preferably the laminate comprises an aluminium magnesium alloy sheet such as 5182, or aluminium manganese alloy such as 3004

with a layer of polyester film on one side. A polypropylene film may be used on the "other side" if desired.

5

Typical dimensions of the example of the invention are:-

d ₅	overall diameter (as stamped)	65.83mm
d ₄	PC diameter of seaming panel radius	61.54mm
d ₃	PC diameter of seaming panel/chuck wall radius	59.91mm
r ₁	seaming panel/chuck wall radius	1.27mm
r ₂	seaming panel radius	5.56mm
r ₃	concave radius in antipeaking bead	<1.5mm
d ₂	maximum diameter of antipeaking bead	50.00mm
d ₁	minimum diameter of antipeaking bead	47.24mm
h ₂	overall height of can end	6.86mm
h ₁	height to top of antipeaking bead	5.02mm
h ₃	panel depth	2.29mm
h ₄	outer wall height	1.78mm
c	chuck wall angle to vertical	43°

10 From these dimensions it can be calculated that the ratio of central panel diameter of 47.24mm to overall diameter of can end 65.84 is about 0.72 to 1.

For economy the aluminium alloy is in the form of sheet metal less than 0.010" (0.25mm). A polyester film
15 on the metal sheet is typically 0.0005" (0.0125mm).

Although this example shows an overall height h₂ at 6.86mm we have also found that useful can ends may be made with an overall height as little as 6.35mm (0.25").

Figure 5 shows the peripheral flange 23 of can end 22 of Figure 4 resting on the flange 11 of a can body 12 before formation of a double seam as discussed with reference to Figure 1.

5 In Figure 5 a modified chuck 30 comprises a chuck body 31 having a frustoconical drive surface 32 engaging with the chuck wall 24 of the can end 22.

 The frustoconical drive surface is inclined outwardly and axially at an angle substantially equal to
10 the angle of inclination C° of between 20° and 60° ; in this particular example on chuck angle C of 43° is preferred. The drive surface 32 is a little shorter than the chuck wall 24 of the chuck body. The substantially cylindrical surface portion 33, rising above the drive
15 surface 32, may be inclined at an angle between $+4^\circ$ and -4° to a longitudinal axis of the chuck. As in Figure 2, this modified chuck 30 has a threaded aperture to permit attachment to the rest of the double seam forming apparatus (not shown).

20 In contrast to the chuck of Figure 2 the modified chuck 30 is designed to drive initially on the relatively large chuck wall 32 without entering deeply into the anti-peaking bead 25. Further drive is obtained at the juncture of chuck wall 32 and cylindrical wall 33 as
25 chuck wall of end 24 is deformed during 1st and 2nd operation seaming Figure 6 and 7. The chuck 30 shown in Figure 5 has an annular bead of arcuate cross section but this bead is designed to enter the chuck wall without scratching or scuffing a coating on the can end; not to
30 drive on the concave bead surface as shown in Figure 2.

It will be understood that first operation seaming is formed using apparatus as described with reference to Figure 1.

Figure 6 shows the modified can end and chuck during formation of a first operation seam shown at the left of Figure 2 as formed by a first operation roll 34 adjacent the interfolded peripheral flange of the can end and flange 11 body 12.

During relative rotation as between the can end 22 and first operation roll 34 the edge between the chuck drive wall 32 and cylindrical wall 33 exerts a pinching force between chuck 30 and roll 34 to deform the chuck wall of the can end as shown.

After completion of the first operation seam the first operation roll is swung away from the first operation seam and a second operation roll 38 is swung inwards to bear upon the first operation seam supported by the chuck 30. Relative rotation as between the second operation roll 38 and first operation seam supported by a chuck wall 30 completes a double seam as shown in Figure 7 and bring the upper portion 24 of the chuck wall 24 to lie tightly against the can body neck in a substantially upright attitude as the double seam is tightened by pinch pressure between the second operation roll 38 and chuck 30.

Can ends according to the invention were made from aluminium alloy 5182 and an aluminium alloy 3004/polymer laminate sold by CarnaudMetalbox under the trade mark ALULITE. Each can end was fixed by a double seam to a drawn and wall ironed (DWI) can body using various chuck angles and chuck wall angle as tabulated in Table 1 which

records the pressure inside a can at which the can ends
failed:-

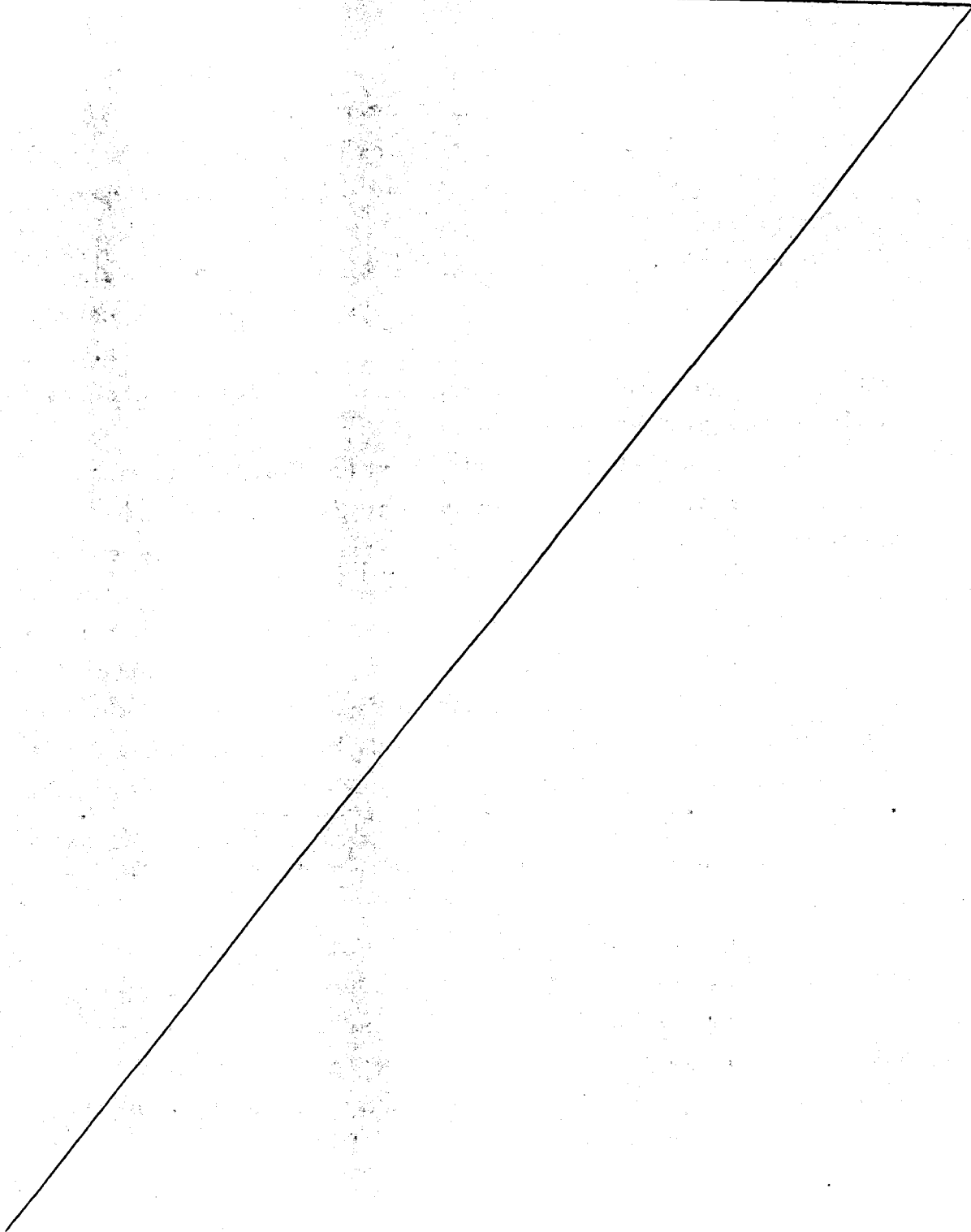


TABLE 1

SAMPLE CODE	CAN END DATA			PRESSURE (PSIG) TO FAILURE FOR VARIOUS SEAMING CHUCK ANGLES B°				
	MATERIAL Thickness mm	MINIMUM Diameter D _i	CHUCK WALL ANGLE "C"	23°	10°/23°	4°/23°	23° WITH D. SEAM RING	10°/23° WITH D. SEAM RING
A	ALULITE							
	0.23	2.052"	21.13°	80.20	83.10	76.97	87.17	85.14
B	5182							
	0.244	2.052"	21.13°	81.15	80.79	77.99	86.01	85.43
C	5182							
	0.245	2.052"	21.13°	87.02	85.65	84.06	90.21	92.54
D	ALULITE							
	0.23	2.044"	21.13°	77.31	75.78	75.91	83.04	78.32
E	5182							
	0.224	2.044"	21.13°	80.50	79.92	77.60	85.43	85.94
F	5182							
	0.245	2.044"	23°	84.63	84.12	82.59	90.58	93.26
G	ALULITE							
	0.23	2.044"	23°			74.25		
H	5182							
	0.224	2.044"	23°			79.34		
I	5182							
	0.245	2.044"	23°			82.58		

All pressures on unaged shells in psig. 5182 is an aluminium-magnesium-manganese alloy lacquered.
 The "ALULITE" used is a landmark of aluminium of aluminium alloy-manganese and polyester film - μ thick

The early results given in Table 1 showed that the can end shape was already useful for closing cans containing relatively low pressures. It was also observed that clamping of the double seam with the "D" seam ring resulted in improved pressure retention. Further tests were done using a chuck wall angle and chuck drive surface inclined at nearly 45°: Table 2 shows the improvement observed:-

Table 2

10

Sample Code	h ₂ "	h ₃ "	h ₄ "	Chuck Angles B°	
				43°	43° with seam ring
J	0.270	0.094	0.09	70.9	89.1
K	0.280	0.104	0.10	70.0	86.6
L	0.290	0.114	0.11	68.7	93.3

Table 2 is based on observations made on can ends made of aluminium coated with polymer film (ALULITE) to have a chuck wall length of 0.198" up the 43° slope.

It will be observed that the container pressures achieved for samples J, K L 70.9, 70.0 and 68.7 respectively were much enhanced by clamping the double seam.

20 In order to provide seam strength without use of a clamping ring, modified chucks were used in which the drive slope angle C° was about 43° and the cylindrical surface 33 was generally +4° and -4°. Results are shown in Table 3.

Table 3 Results

SAMPLE CODE	MATERIAL	LINING COMPOUND	CHUCK ANGLES DRIVE/WALL	PRESSURE
c	0.224 5182	with	43°	66.7
g	0.23 Alulite	with	43°/4°	79.0
h	0.224 5182	with	43°/4°	93.6
j	0.23 Alulite	without	43°/4°	85.6
k	0.244 5182	without	43°/4°	89.6
l	0.23 Alulite	without	43°/-4°	77.9
m	0.25 Alulite	without	43°/-4°	89.8
n	0.23 Alulite	without	43°/0°	88.5
o	0.25 Alulite	without	43°/0°	95.9

ALL PRESSURES IN PSIG

5 ALL CODES

Reform Pad Dia. 1.860 (202 Dia).

0.270" unit Depth h₂ 0.094" Panel Depth

Table 3 shows Code "O" made from 0.25mm Alulite to give 95 psi Pressure Test Result indicating a can end suitable for pressurised beverages. Further chucks with various land lengths (slope) were tried as shown in Table 4.

10

Table 4

CHUCK WALL ANGLE				
VARIABLE CODE	43°/0° 1.9mm LAND SHARP TRANSITION		43°/0° 1.27MM LAND R. 0.5MM BLEND	
	NO. D.SEAM RING	WITH D.SEAM RING	NO. D.SEAM RING	WITH D.SEAM RING
7	97.08	101.7	98.24	101.54
8	91.52	94.5	91.2	90.37
9	88.33	91.3	90.4	97.38

ALL PRESSURES IN PSIG

5 CODE

7 = 0.25mm Alulite, O 1.860" Reform Pad, 0.270" h_2 Depth,
0.94" Panel; h_1 depth = 0.09"

8 = 0.23mm Alulite, O 1.860" Reform Pad, 0.280" h_2 Depth,
0.104" Panel; h_1 depth = 0.10"

10 9 = 0.23mm Alulite, O 1.860" Reform Pad, 0.290" h_2 Depth,
0.114 Panel; h_1 depth = 0.11"

Table 4 shows results of further development to seaming chuck configuration to bring closer the pressure resistance of ring supported and unsupported double seams.

15 Table 4 identifies parameters for length of generally vertical cylindrical surface 33 on the seaming chuck 30, and also identifies a positional relationship between the chuck wall 24 of the end and the finished double seam. It will be understood from Figure 7 shows
20 that the forces generated by thermal processing or carbonated products are directed towards and resisted by the strongest portions of the completed double seam.

Table 5 Shows results obtained from a typical seam chuck designed to give double seam in accordance with parameters and relationships identified in Table 4.

Typically:- As shown in Figure 8 the chuck comprises a cylindrical land of length 'l' typically 0.075" and frustoconical drive surface 32 inclined at an angle γ° , typically 43° , to the cylindrical to which it is joined by a radius R typically 0.020". Angle "X" is typically 90° .

Table 5

CODE	GAUGE	DIMENSIONS		PRESSURE (AVE)	
		h_2	h_3	PSI	(bar)
20	.23mm	.290"	.093"	92.6	(6.383)
21	.23mm	.290"	.093" with compound	92.8	(6.402)
26	.23mm	.2705"	.0935"	89.88	(6.144)
27	.23mm	.2705"	.0934" with compound	88.0	(6.071)
28	.23mm	.290"	.093"	93.0	(6.414)
29	.23mm	.290"	.112"	97.5	(6.725)
30	.23mm	.270"	.0935"	87.9	(6.062)
31	.23mm	.270"	.0935"	87.2	(6.013)
34	.25mm	.290"	.113"	112.9	(7.787)
36	.25mm	.288"	.092"	105.8	(7.293)
37	.25mm	.288"	.092" with compound	107.3	(7.402)
38	.25mm	.2705"	.095"	102.6	(7.077)
516	.25mm	.250"	.092 with compound	100.6	(6.937)

All variables made from Alulite, 10 Cans per variable.

The can ends may be economically made of thinner metal if pressure retention requirements permit because these can ends have a relatively small centre panel in a stiffer annulus.

Figure 9 shows a can 12a, closed according to this invention, stacked upon a like can 12b shown sectioned so that stacking of the upper can on the lower can end is

Figure 9 shows a can 12a, closed according to this invention, stacked upon a like can 12b shown sectioned so that stacking of the upper can on the lower can end is achieved by a stand bead 31a of the upper can fits inside
5 the chuck wall 24 of the lower can end with the weight of the upper can resting on the double seam 34 of the lower can end.

The clearance between the bottom of the upper can body and lower can end may be used to accommodate ring
10 pull features (not shown) in the can end or promotional matter such as an coiled straw or indicia.

Using the experimental data presented above, a computer programme was set up to estimate the resistance to deformation available to our can ends when joined to
15 containers containing pressurised beverage. The last two entries on the table relate to a known 206 diameter beverage can end and an estimate of what we think the KRASKA patent teaches.

TABLE 6

END SIZE Bead Ø: DIA ID d ₂ : d ₁	OVERALL DIA d ₂	PANEL DIA d ₁	RATIO D ₂ /D ₁	CHUCK WALL ANGLE B°	CHUCK WALL LENGTH L	RE- ENFORCING RAD r ₂	INNER WALL HEIGHT h ₃	OUTER WALL HEIGHT h ₄	PREDICTED CUT EDGE Ø (* DENOTES ACTUAL)	ACTUAL THICKNESS TO CONTAIN PSI
206-204	2.535"	1.9485"	1.3010	33.07°	0.166"	0.0204"	0.092"	0.070"	2.9618"	0.255
206-202	2.535"	1.8634"	1.3604	42.69°	0.195"	0.0204"	0.092"	0.070"	2.9241**	0.255
206-200	2.535"	1.7744"	1.4287	50.053°	0.229"	0.0204"	0.092"	0.070"	2.9021"	0.255
204-202	2.448"	1.8634"	1.3137	29.78°	0.156"	0.0204"	0.092"	0.070"	2.9042"	0.24
204-200	2.448"	1.7744"	1.3796	40.786°	0.185"	0.0204"	0.0092"	0.070"	2.8705"	0.24
202-200	2.834"	1.7744"	1.597	30.266°	0.161"	0.0204"	0.092"	0.070"	2.834"	0.225
206 std	2.547"	2.044"	1.2461	15.488°	0.173"	0.022"	0.080"	-	3.010**	0.28
KRASKA ESTIMATE	(eg 2.535")	-	-	15°	0.100"	0.032"	0.065"	0.090"	3.074"	0.292 (0.0115")

All experiments modelled on a notional aluminium alloy of yield strength 310mpa 0.25mm thick. The standard was also 310mpa BUT 0.275mm thick.

CLAIMS

1. A can end comprising a peripheral cover hook, a chuck wall dependent from the interior of the cover hook, an outwardly concave annular reinforcing bead extending radially inwards from the chuck wall, and a central panel supported by an inner portion of the reinforcing bead, characterised in that, the chuck wall is inclined to an axis perpendicular to the exterior of the central panel at an angle c between 20° and 60° , and the concave cross sectional radius of the reinforcing bead is less than 0.75mm.
2. A can end according to claim 1 wherein the angle of the chuck wall to the perpendicular is between 40° and 45° .
3. A can end according to claim 1 or claim 2 wherein an outer wall of the reinforcing bead is inclined to a line perpendicular to the central panel of the can end at angle between -15° and $+15^\circ$ and the height h_4 of the outer wall is up to 2.5mm.
4. A can end according to claim 1 to claim 2 wherein the reinforcing bead has an inner portion parallel to an outer portion joined by said concave radius.
5. A can end according to any preceding claim wherein the ratio of the diameter of the central panel to the diameter of the peripheral curl is 80% or less.
6. A can end according to any preceding claim when made of a laminate of thermoplastic polymer film and a sheet aluminium alloy or tinplate or electrochrome coated steel.

7. A can end according to claim 5 wherein the laminate comprises a polyethylene terephthalate film on an aluminium - manganese - alloy sheet less than 0.010 (0.25mm) thick.

8. A method of forming a double seam between a can body and a can end according to any preceding claim, said method comprising the steps of:-

placing the curl of the can end on a flange of a can body supported on a base plate; locating a chuck within the chuck wall of the can end, said chuck having a frustoconical drive surface of substantially equal slope B° to that of the chuck wall of the can end and a substantially cylindrical surface portion extending away from the drive surface; causing relative motion as between the assembly of can end and can body and a first operation seaming roll to form a first operation seam, and thereafter causing relative motion as between the first operation seam and a second operation roll to complete a double seam, during these seaming operations the chuck wall of the can end becoming bent to contact the cylindrical portion of the chuck.

9. A method according to claim 8 wherein the substantially cylindrical surface portion of the chuck is inclined at an angle between $+4^\circ$ and -4° to the longitudinal axis of the chuck.

10. A can end substantially as herein before described with reference to Figures 4 or 7 of the accompanying drawings.

11. A method of forming a double seam substantially as hereinbefore described with reference to Figures 5 to 8 of the accompanying drawings.

THIS PAGE BLANK (USPTO)

THIS PAGE BLANK (USPTO)

Fig.4.

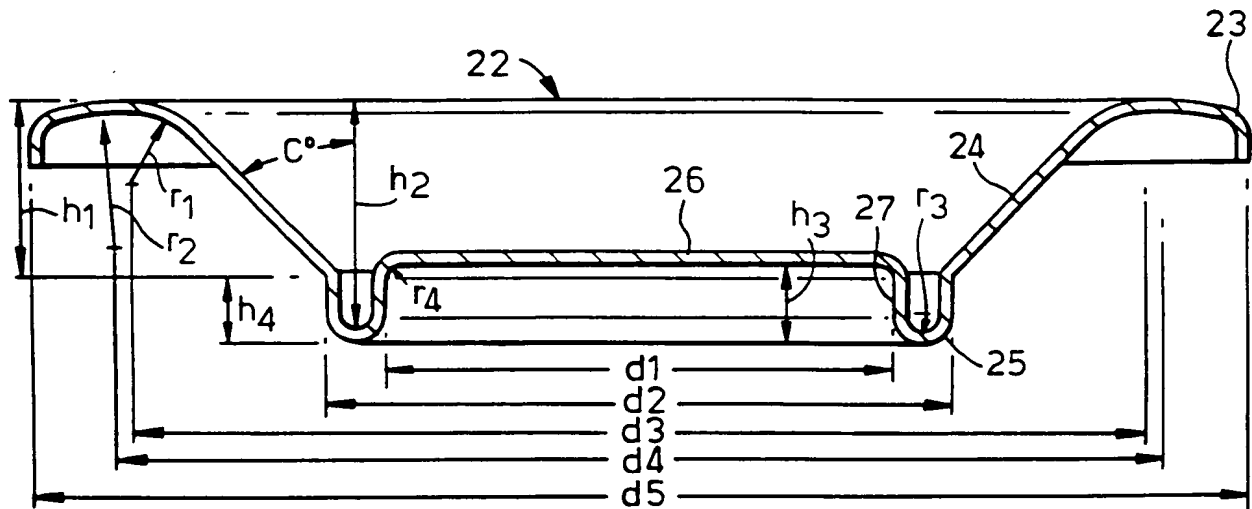
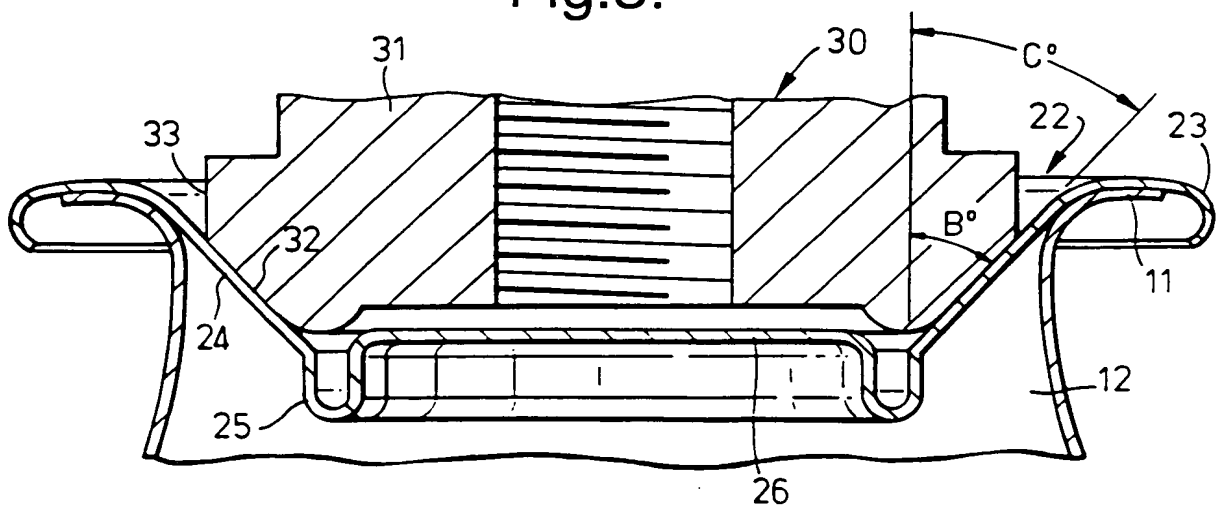


Fig.5.



THIS PAGE BLANK (USPTO)

Fig.6.

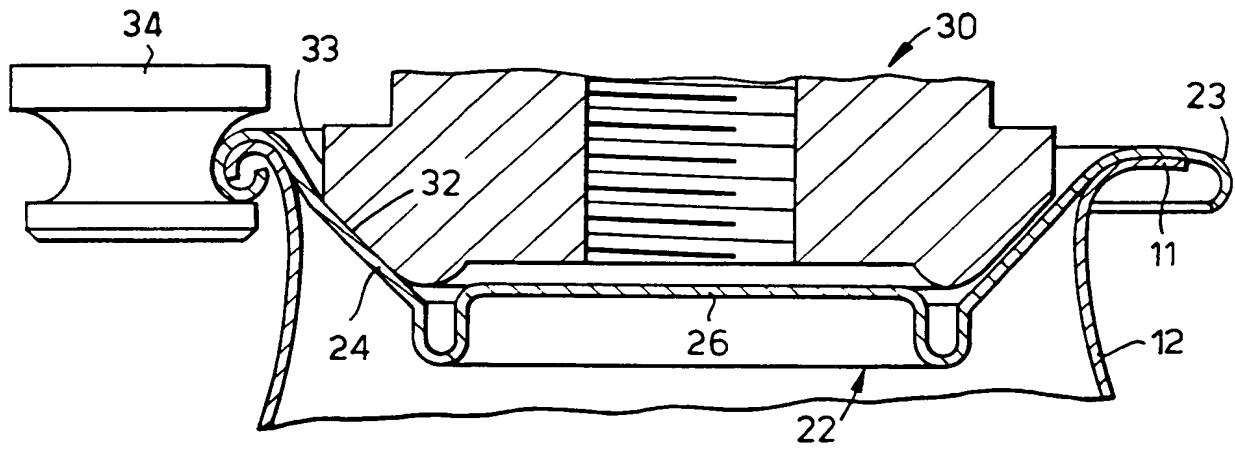
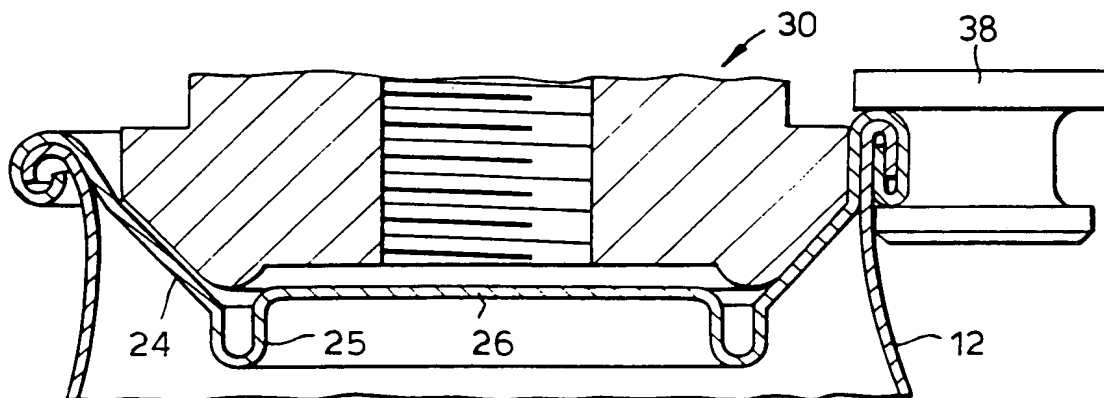
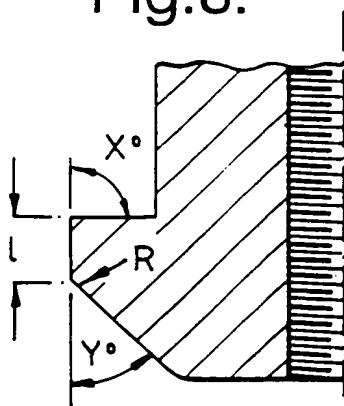


Fig.7.



THIS PAGE BLANK (USPTO)

Fig.8.



12a

31a

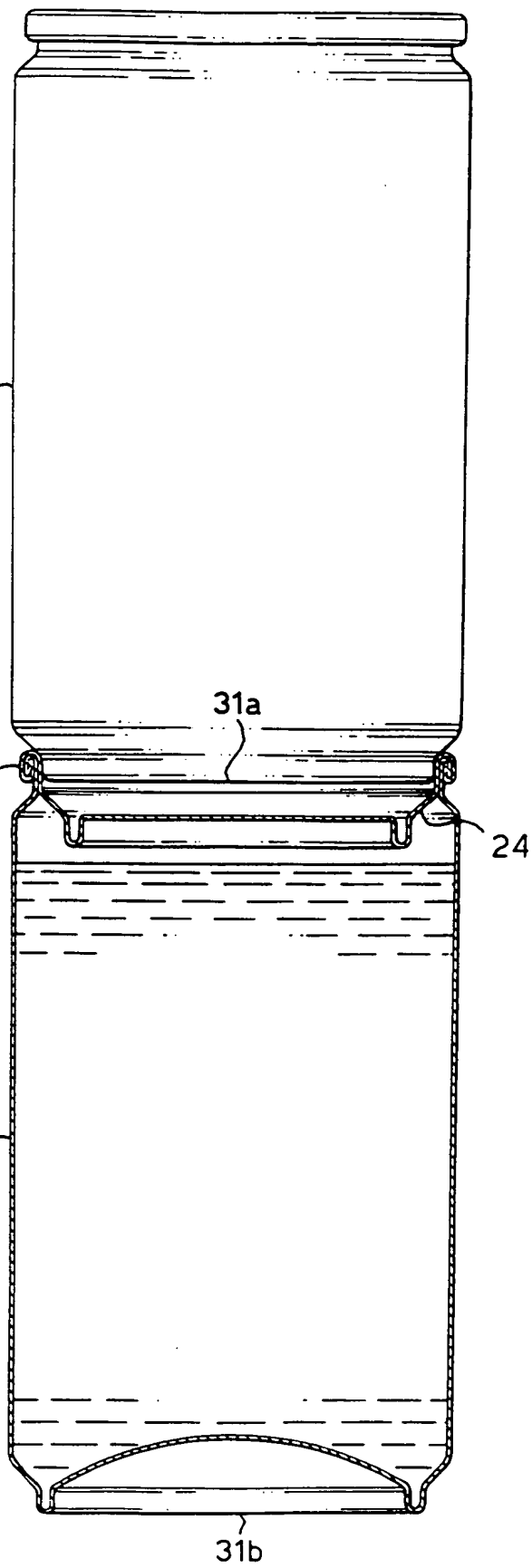
34

24

Fig.9.

12b

31b



THIS PAGE BLANK (USPTO)

INTERNATIONAL SEARCH REPORT

International Application No.

GB 96/00709

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B65D6/30 B21D51/32

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B65D B21D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP,A,0 340 955 (CMB PACKAGING) 8 November 1989 see column 8, line 10 - line 50; figure 18 ---	1,4
X	US,A,4 217 843 (KRASKA) 19 August 1980 see column 7, line 27 - line 46; figures 1-3 ---	1,4
A	US,A,4 093 102 (KRASKA) 6 June 1978 cited in the application see the whole document ---	1
A	US,A,4 578 007 (DIEKHOF) 25 March 1986 see column 4, line 34 - column 7, line 66; figures 1-11 ---	7
A	DE,U,92 11 788 (SCHMALBACH-LUBECA) 7 January 1993 ---	
	--- -/--	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

& document member of the same patent family

Date of the actual completion of the international search

9 September 1996

Date of mailing of the international search report

17.09.96

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax (+31-70) 340-3016

Authorized officer

Martens, L

INTERNATIONAL SEARCH REPORT

inal Application No

PCT/GB 96/00709

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>EP,A,0 153 115 (METAL BOX) 28 August 1985 cited in the application -----</p>	

THIS PAGE BLANK (USPTO)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 96/00709

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A-340955	08-11-89	AU-B- 608443	28-03-91
		AU-B- 3545389	24-11-89
		WO-A- 8910216	02-11-89
		GB-A,B 2218024	08-11-89
		JP-B- 7071710	02-08-95
		JP-T- 3503140	18-07-91
		NO-B- 174284	03-01-94
		US-A- 5046637	10-09-91

US-A-4217843	19-08-80	US-A- 4448322	15-05-84
		GB-A- 1604068	02-12-81

US-A-4093102	06-06-78	JP-A- 51046272	20-04-76

US-A-4578007	25-03-86	NONE	

DE-U-9211788	07-01-93	NONE	

EP-A-153115	28-08-85	US-A- 4571978	25-02-86
		JP-B- 8025555	13-03-96
		JP-A- 60193834	02-10-85
		US-A,B 4606472	19-08-86
		US-A- 4722215	02-02-88

THIS PAGE BLANK (USPTO)